FAST
FORESHORE ASSESSMENT USING SPACE TECHNOLOGY

COASTAL MACROPHYTES CONTRIBUTE TO THE LONG TERM GEOMORPHOLOGICAL STABILITY OF CADIZ BAY

E. P. Morris[1], I. Caballero[2], J. Benavente[1], G. Navarro[2], T. Bouma[3] and G. Peralta[1]

2015 Aquatic Sciences Meeting (ASLO), Granada, Spain. February 26, 2015

[1]Univeristy of Cadiz , [2]ICMAN-CSIC , [3]NIOZ

cei·mar

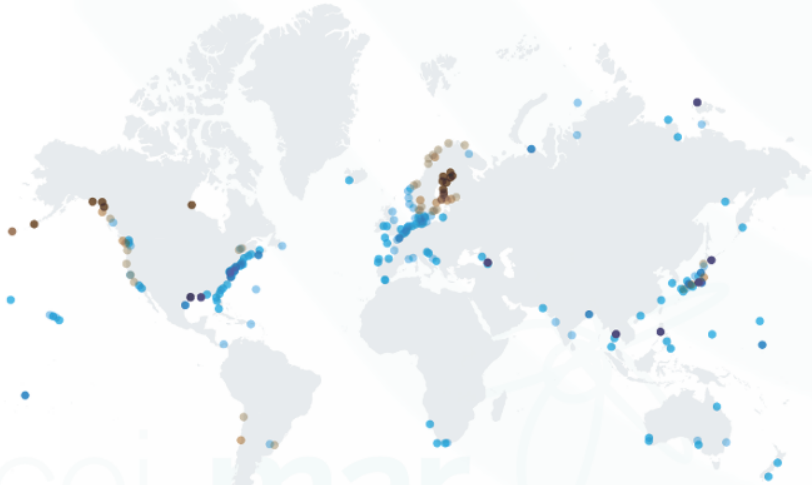
UCA

Higher tide, worldwide

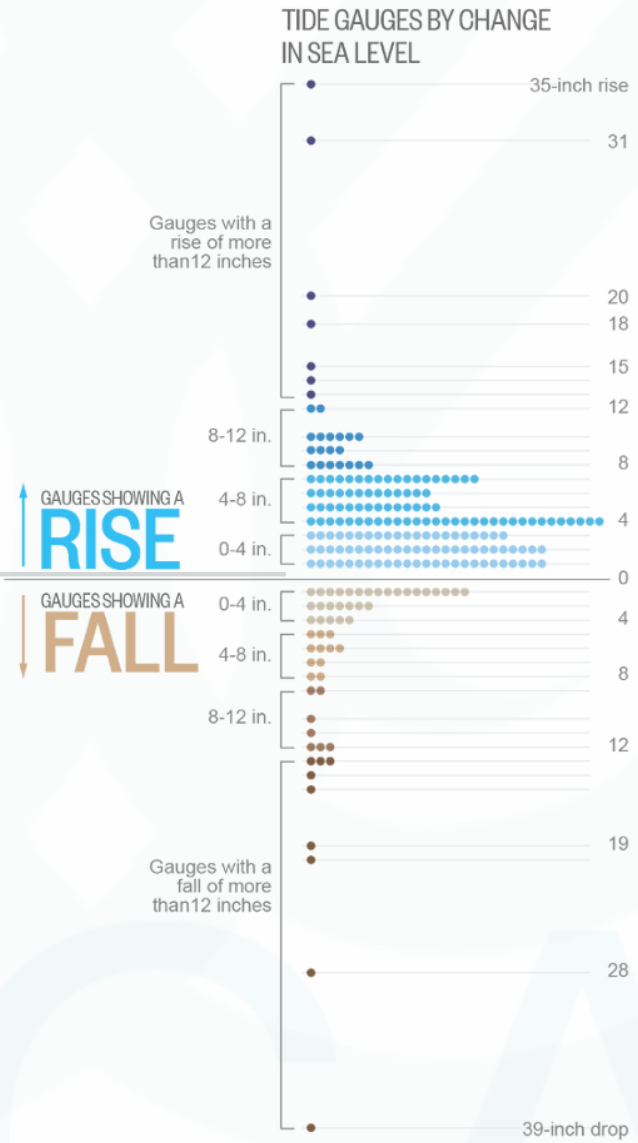
A SHARED EXPERIENCE

TIDE GAUGES BY LOCATION

- Each dot represents one gauge



TIDE GAUGES BY CHANGE IN SEA LEVEL



Source: Reuters analysis of Permanent Service for Mean Sea Level data

The Great Flood








LETTERS
PUBLISHED ONLINE: 18 AUGUST 2013 | DOI: 10.1038/NCLIMATE1979
nature climate change

Future flood losses in major coastal cities

Stephane Hallegatte[1,2]*, Colin Green[3], Robert J. Nicholls[4] and Jan Corfee-Morlot[5]

Even if adaptation investments maintain constant flood probability, subsidence and sea-level rise will increase global flood losses to US$60–63 billion per year in 2050.

Recent sea level rise

Church et al. (2013) IPCC doi:10.1017/CBO9781107415324.026

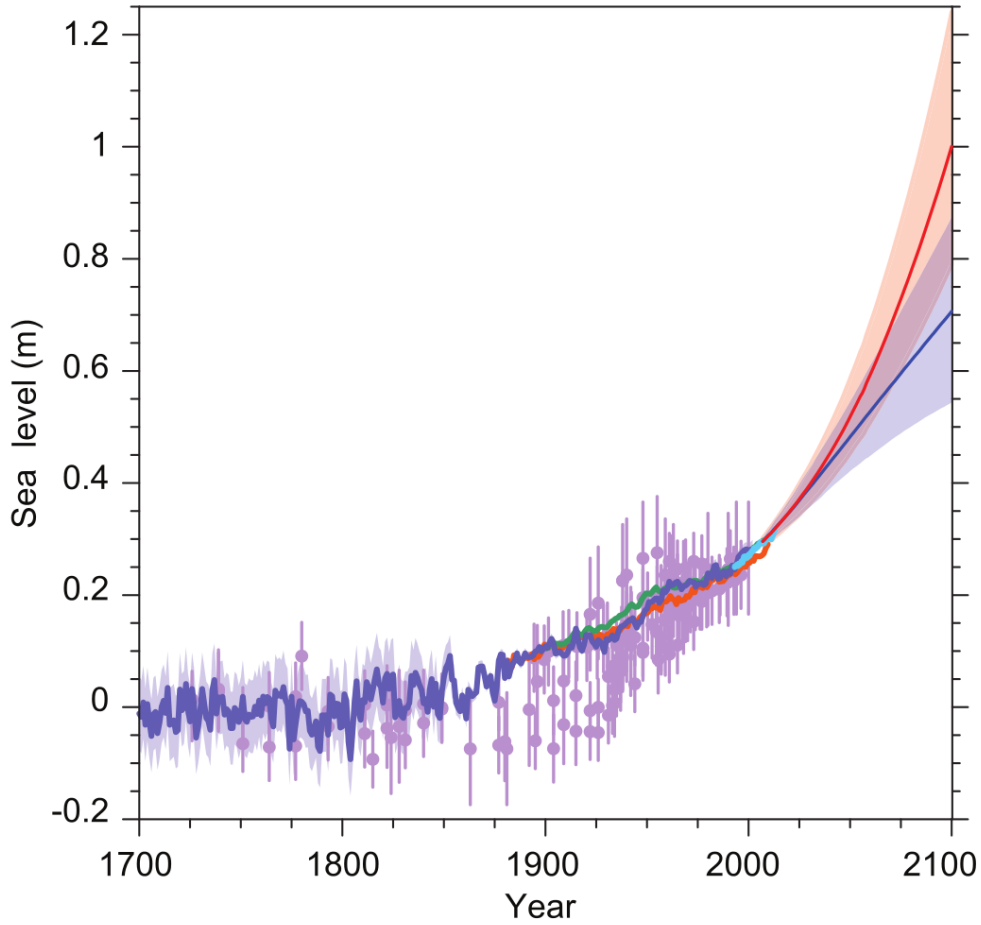
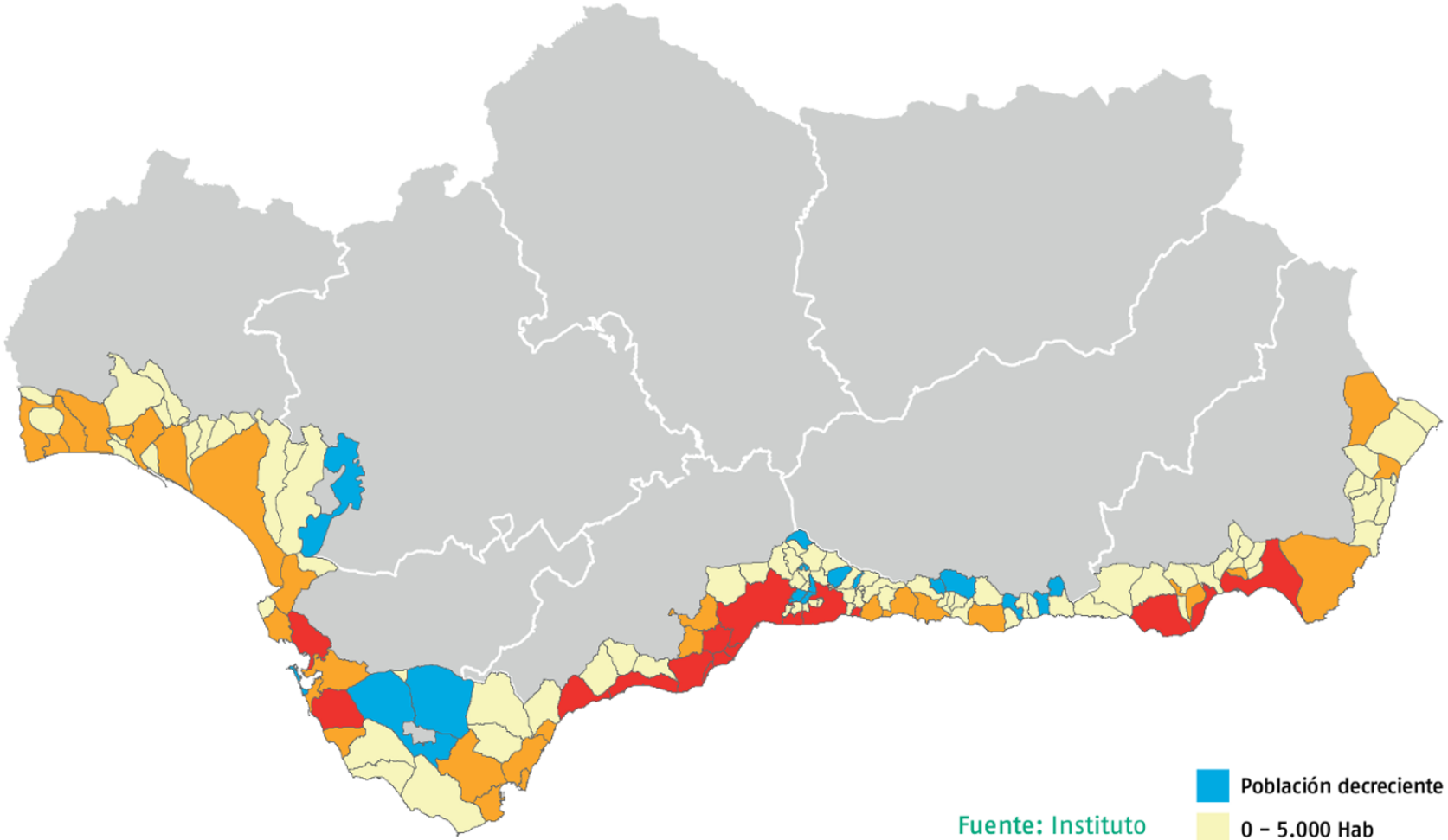


Figure 13.27 | Compilation of paleo sea level data, tide gauge data, altimeter data (from Figure 13.3), and central estimates and *likely* ranges for projections of global mean sea level rise for RCP2.6 (blue) and RCP8.5 (red) scenarios (Section 13.5.1), all relative to pre-industrial values.

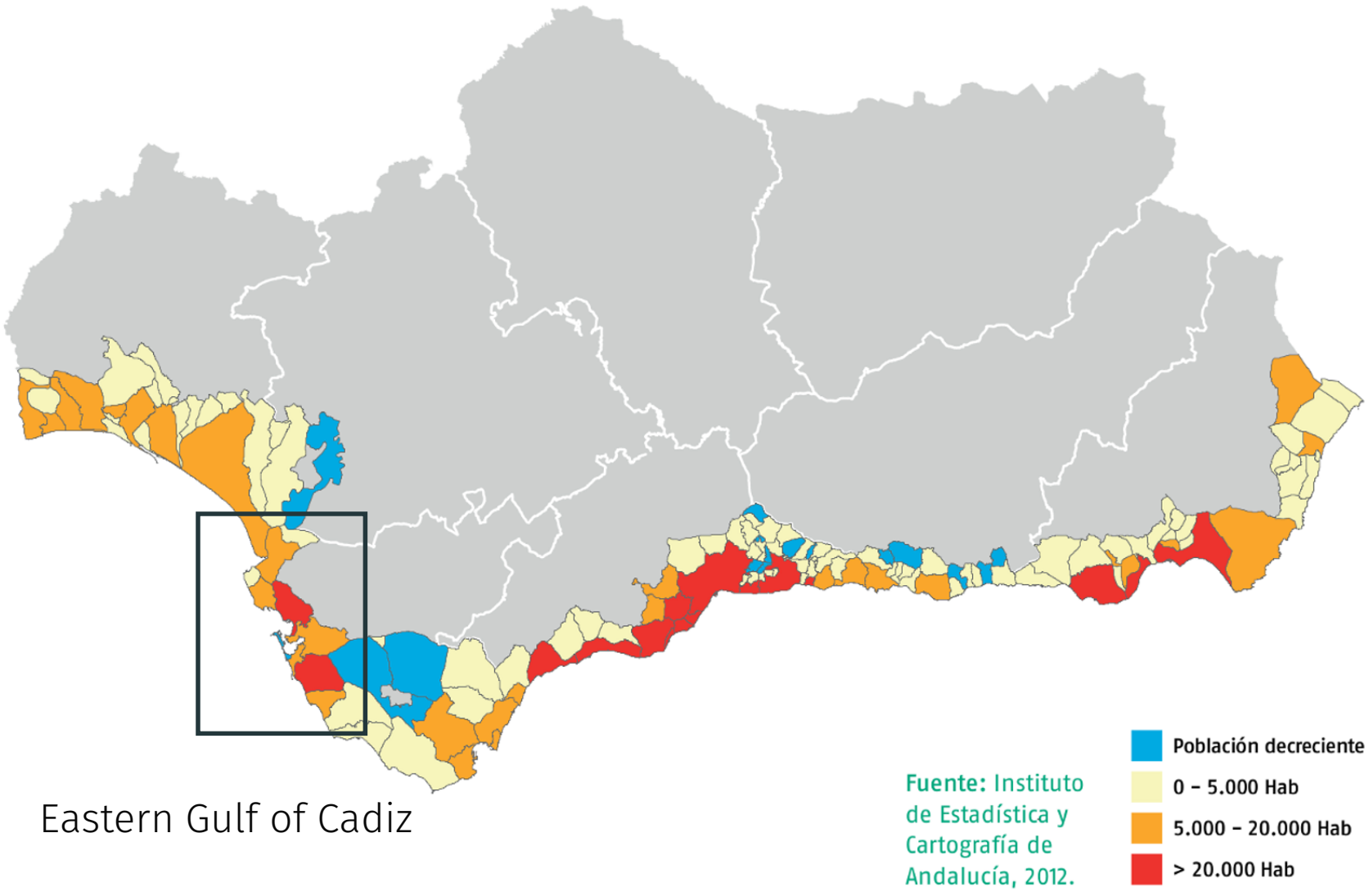
Increasing coastal populations

Incremento de la población en los municipios del litoral de Andalucía, 1991-2011
Population increase in the coastal municiples of Andalucia, 1991-2011



Fuente: Instituto de Estadística y Cartografía de Andalucía, 2012.

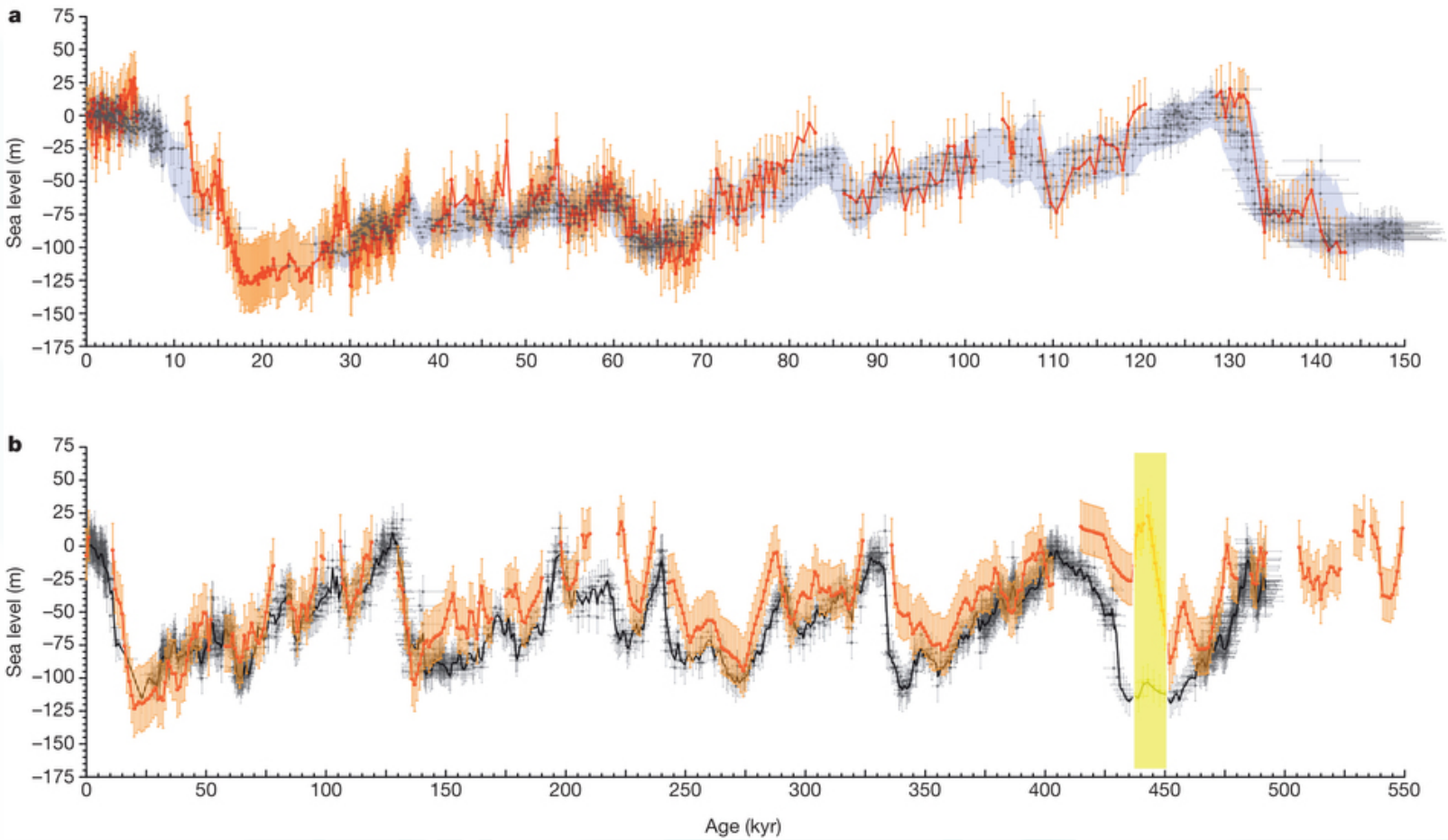
Increasing coastal populations



Eastern Gulf of Cadiz

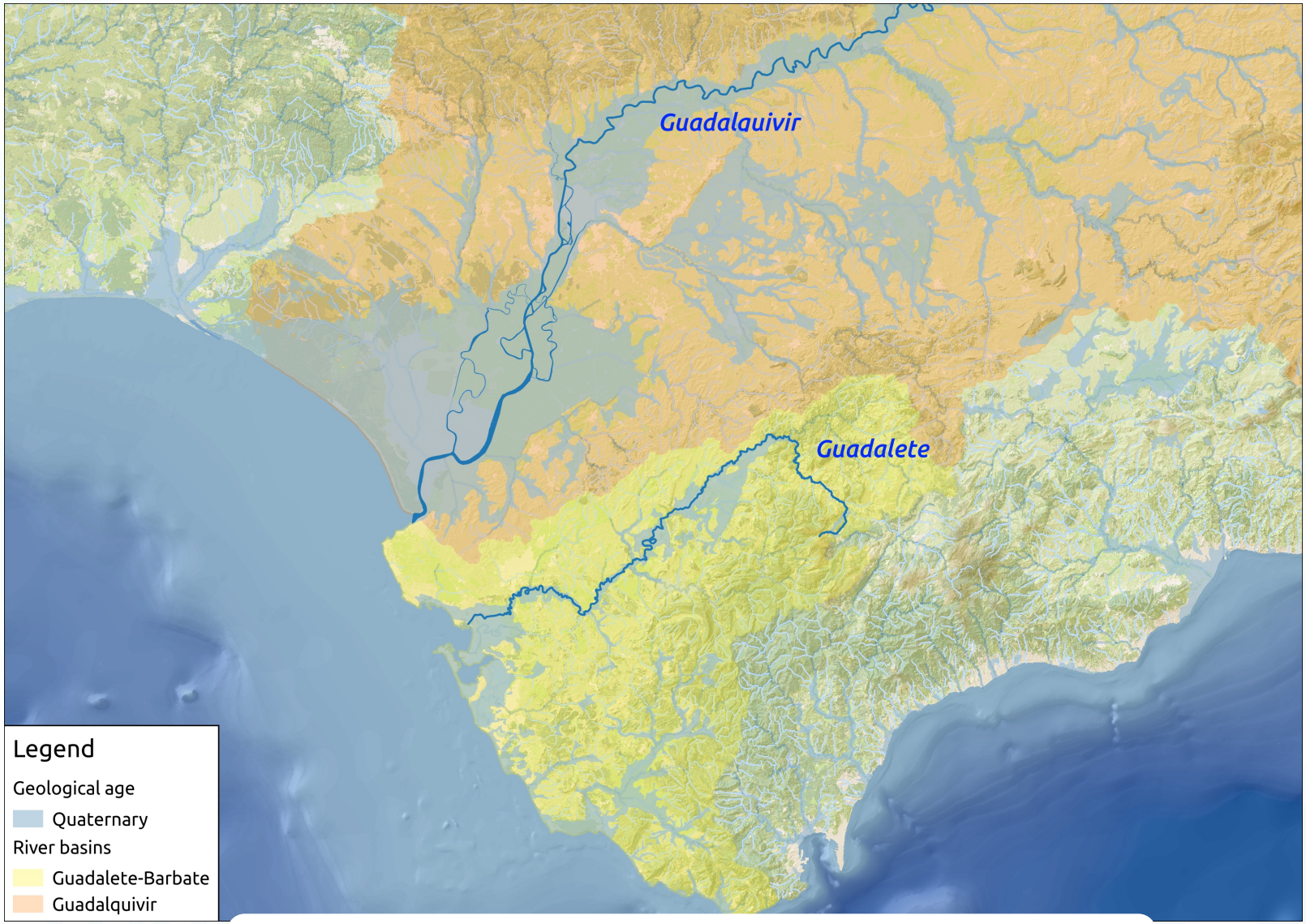
IN TIMES PAST

Relative sea-level (RSL_{GIB} and RSL_{BEM})



EJ Rohling et al. Nature 000, 1-6 (2014) doi:10.1038/nature13230

Paleogeography Eastern Gulf of Cadiz



Adapted from Gracia et al. (2005) Geomorphology of the South-Atlantic Spanish Coast, SEG

Paleogeography Eastern Gulf of Cadiz

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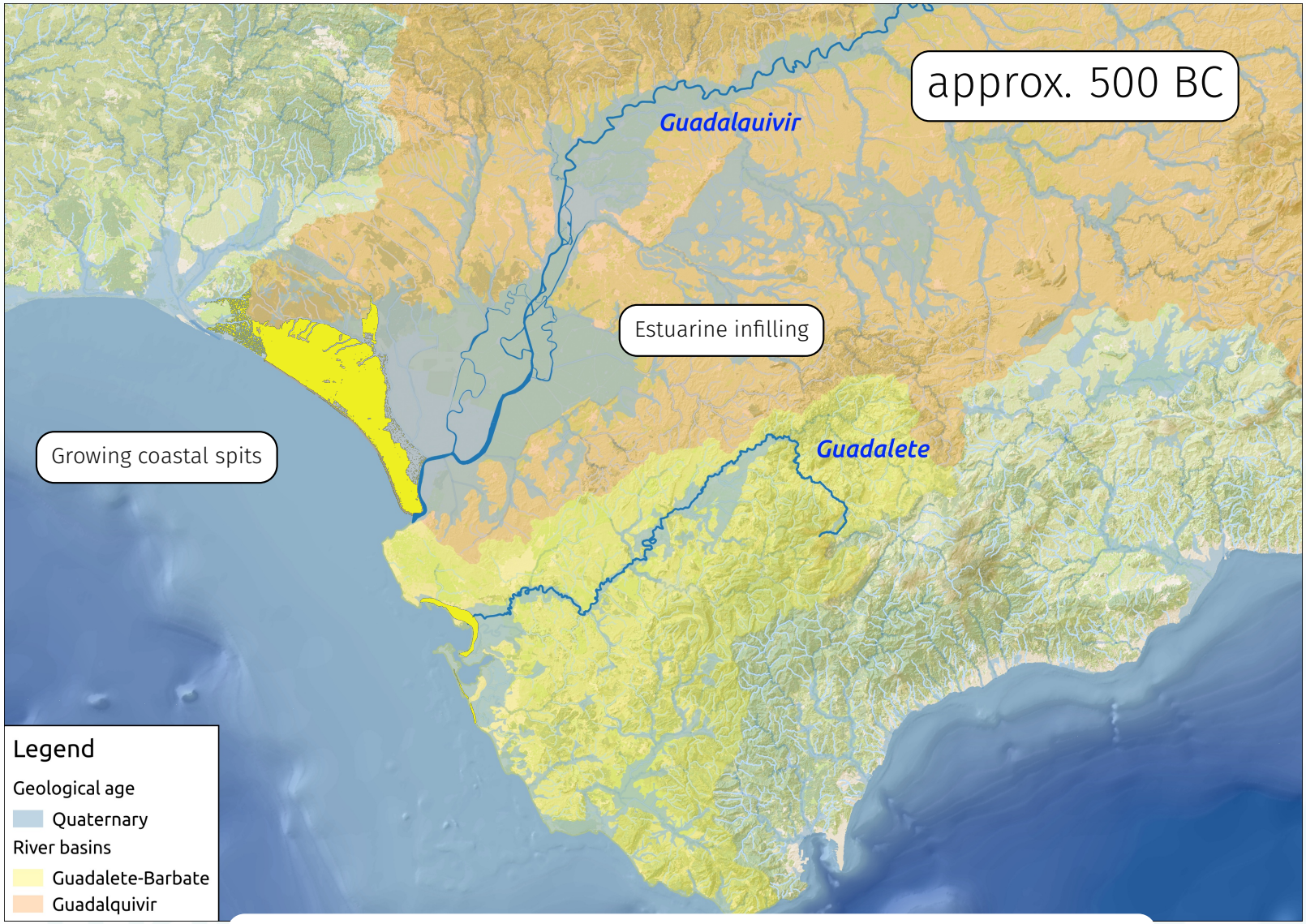

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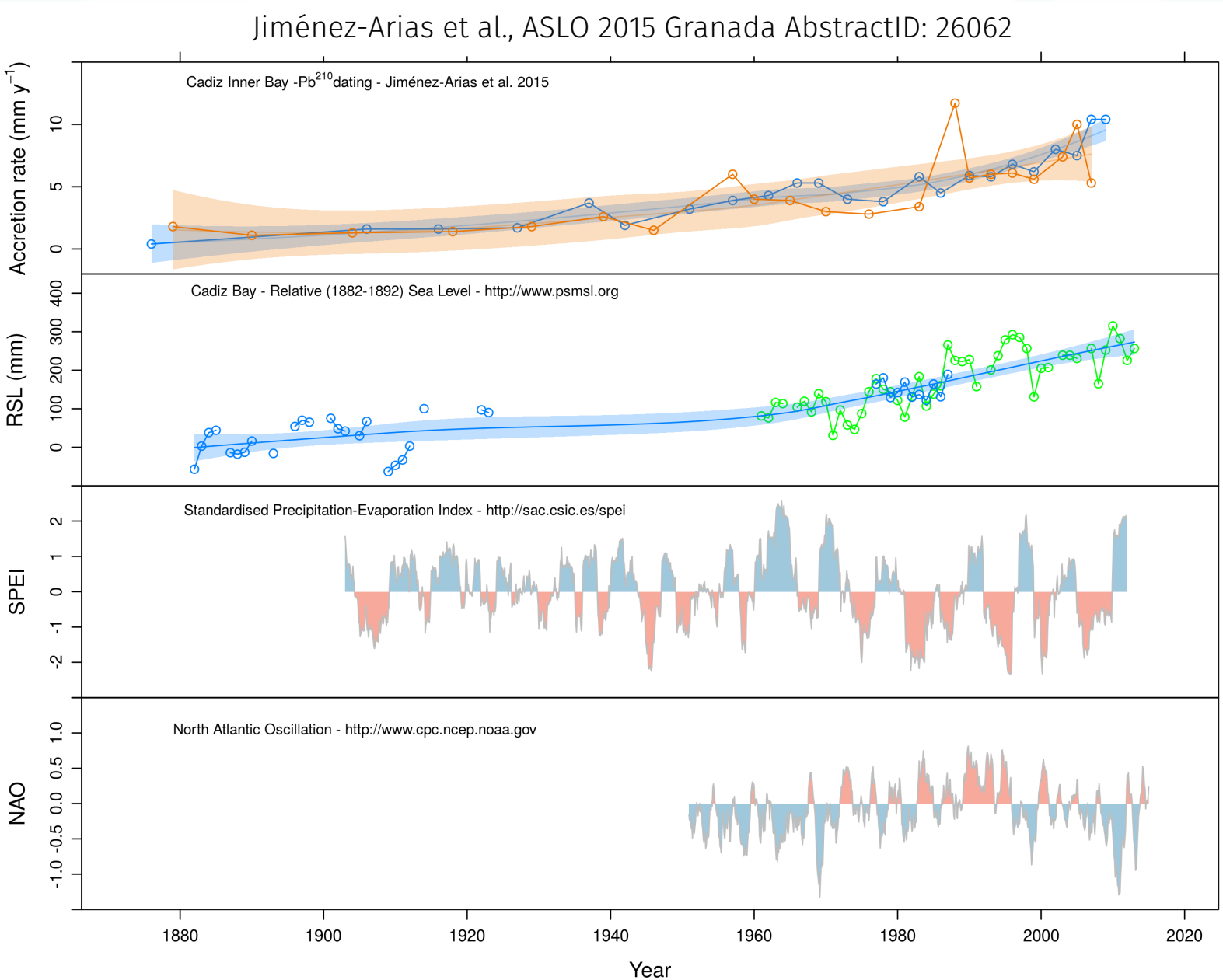
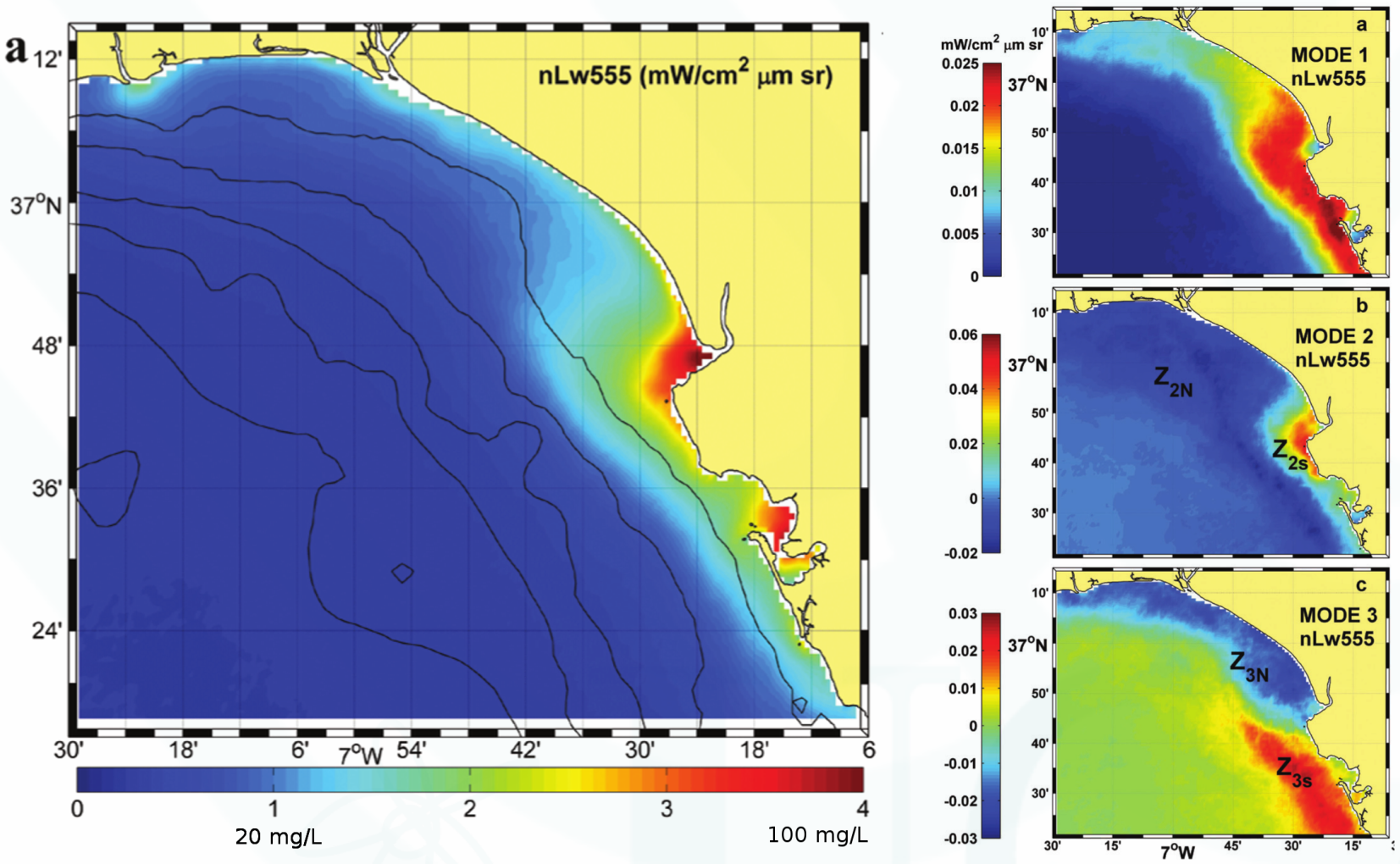
Sediment accretion Cadiz Inner Bay



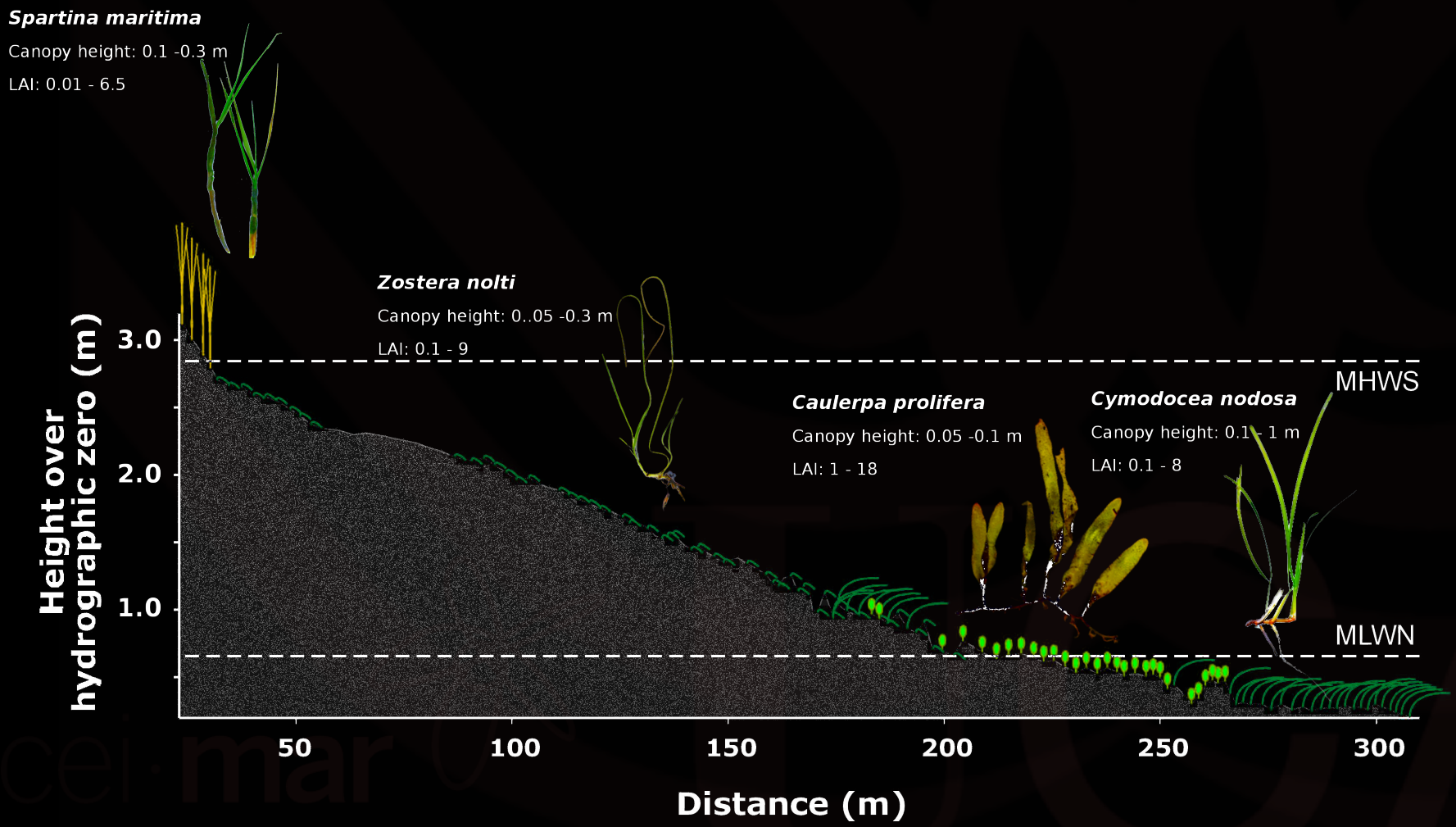
Sediment plumes Gulf of Cadiz (2003-2013)



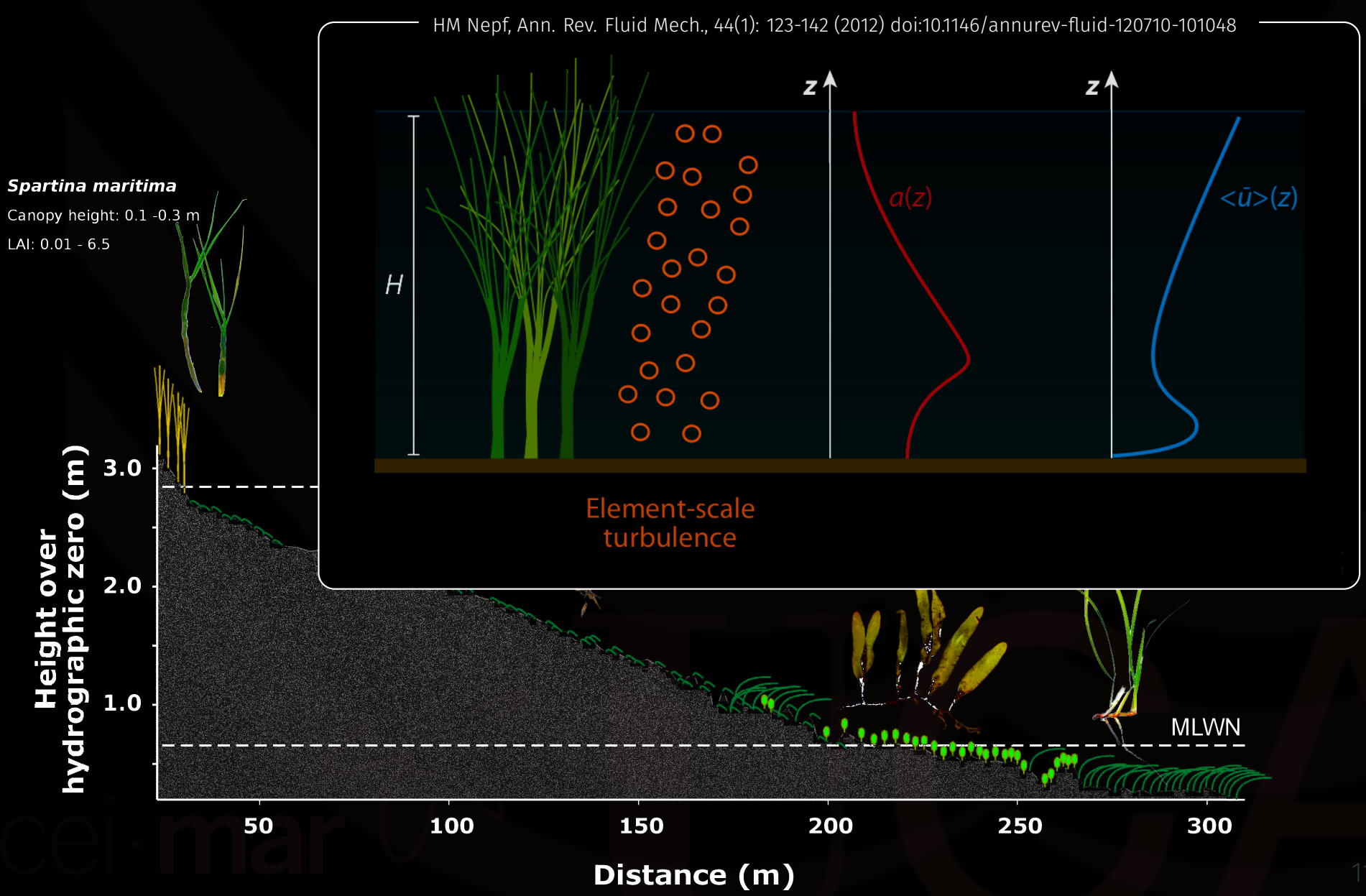
Cabellero et al., Med. Mar Sci., 15(4): 721-738 (2014) doi:10.12681/mms.844

THE ROLE OF PLANTS

Species and context dependent

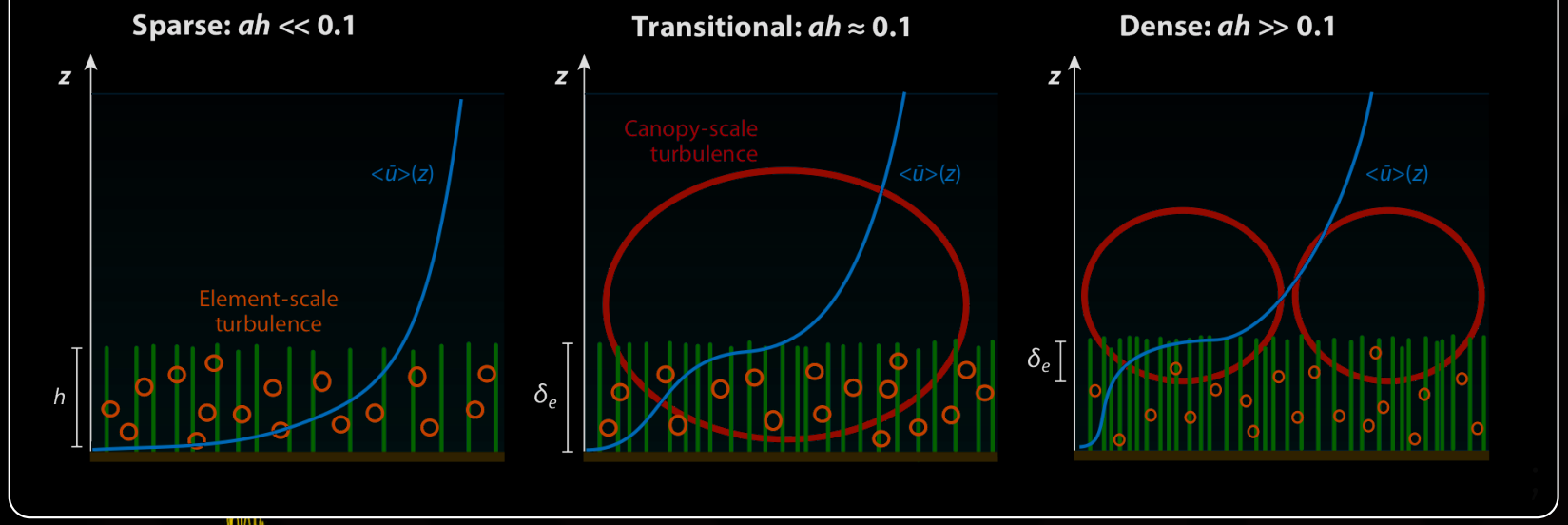


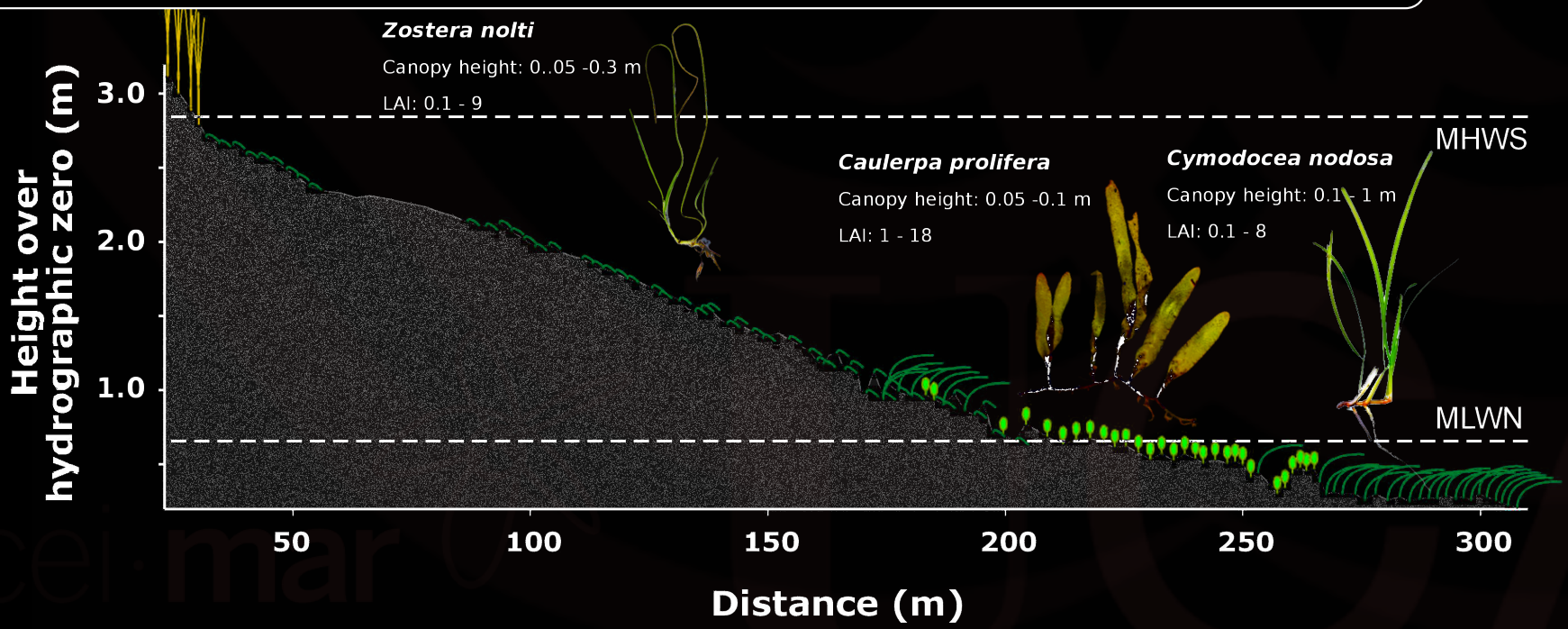
Species and context dependent



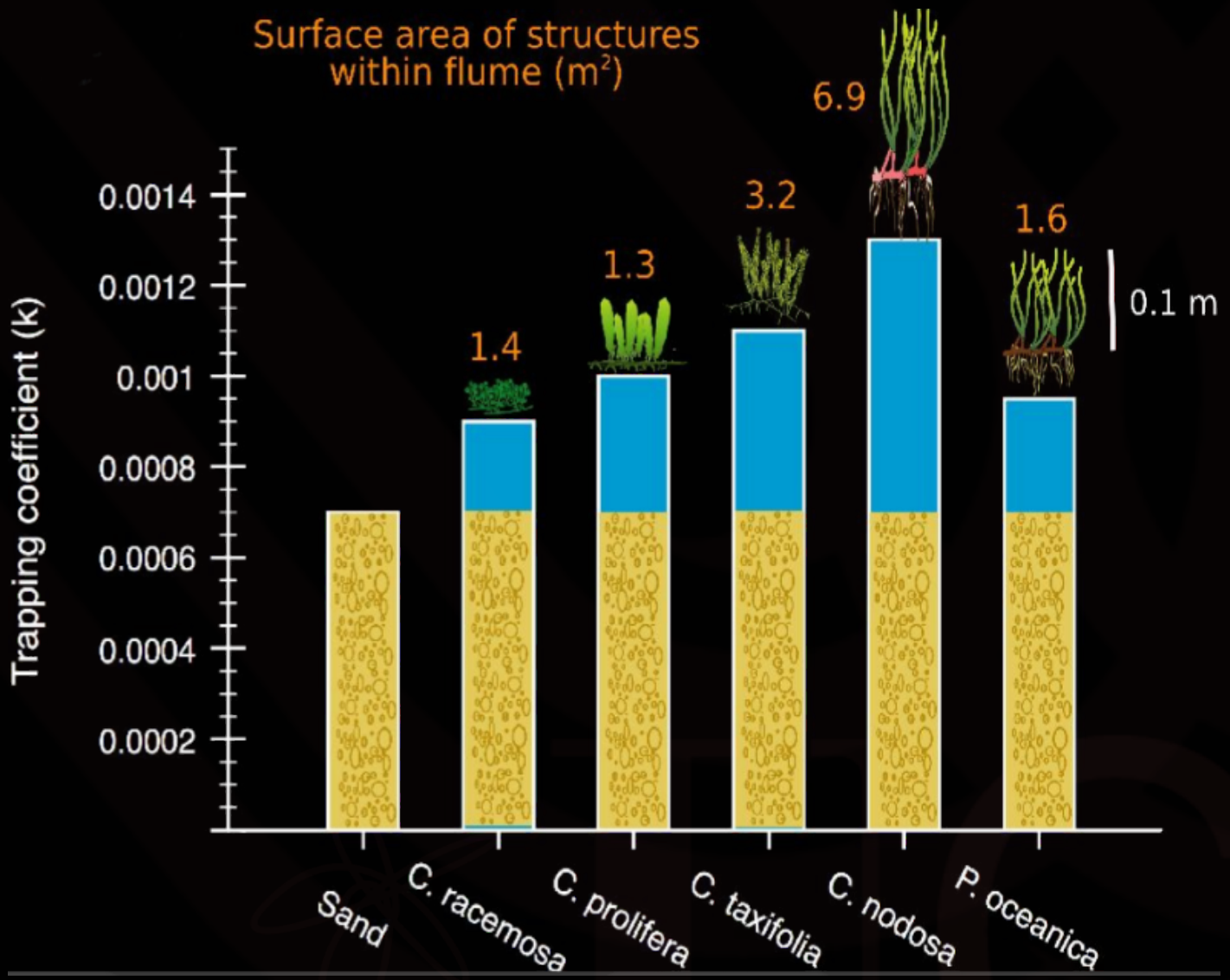
Species and context dependent

HM Nepf Ann. Rev. Fluid Mech. 44(1), 123-142 (2012) doi:10.1146/annurev-fluid-120710-101048



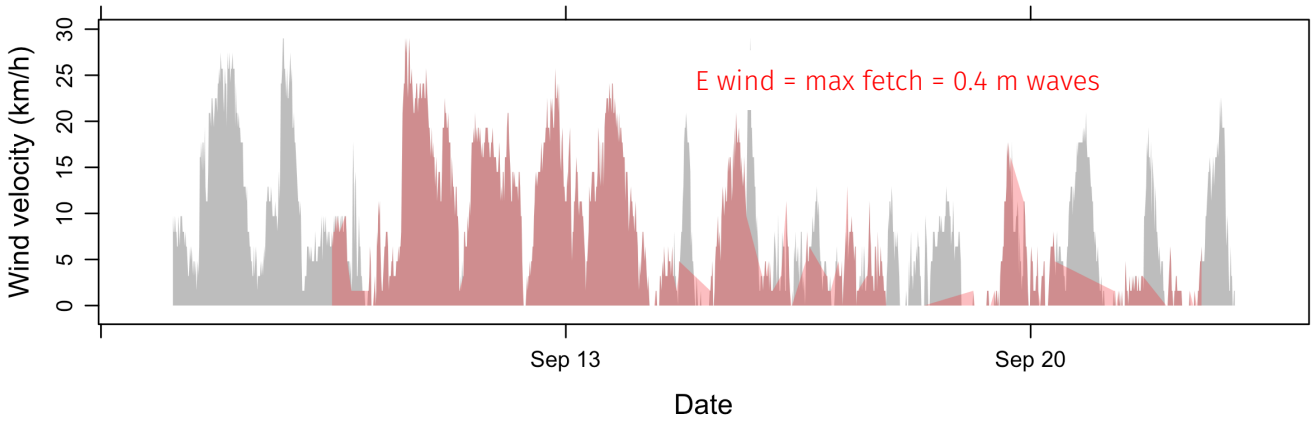


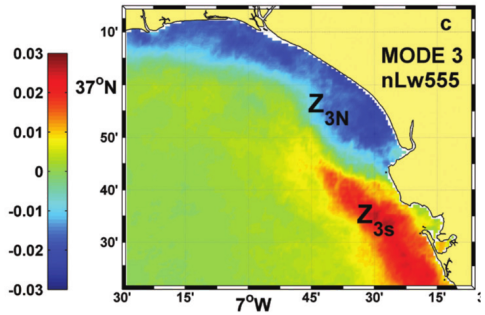
Effects on particle trapping

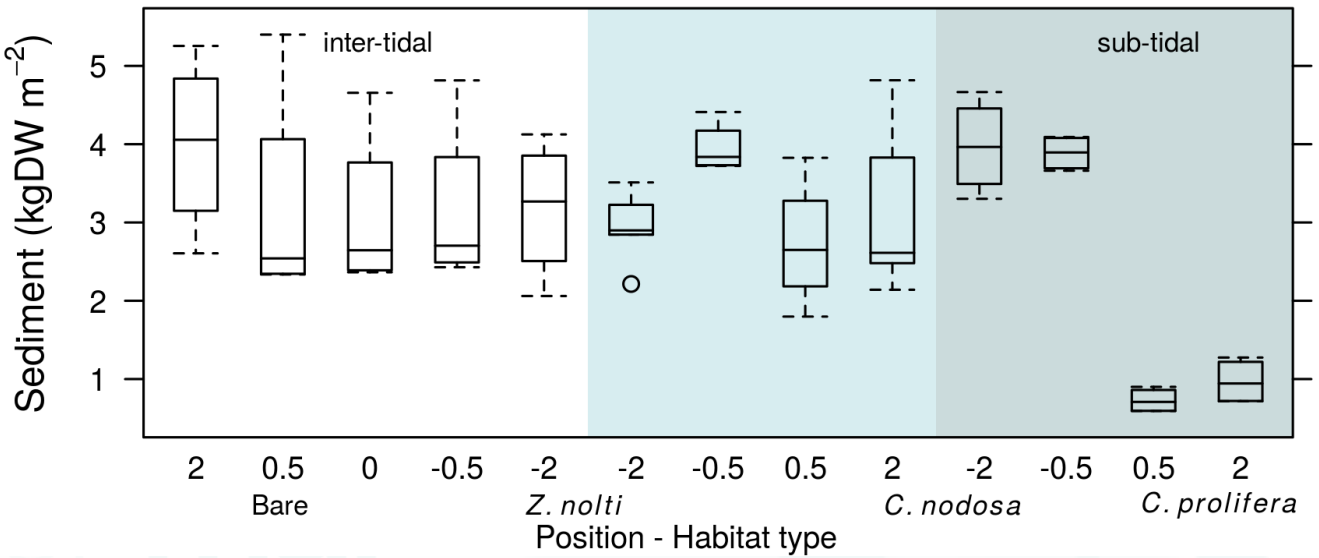


Hendriks et al., Mar. Biol., 157(3): 473-481 (2010) doi:10.1007/s00227-009-1333-8

Effects on sediment mobility







SUMMARY AND OUTLOOK

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- Vertical accrection within Cadiz Inner Bay appears to match or even exceed local relative sea level rise.
- Climate influences the supply rate of fine sediments from the Guadalquivir and Guadalete rivers.
- Coastal macrophytes potentially influence the coastal sediment budget by promoting particle settling and protecting the bed during erosion events
  - In Cadiz Bay subtidal algal canopies with a very high surface area are very effective at bed protection, and must contribute to geomorphological stability.

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Future outlook

- Mediterranean climate change is predicted to include a strengthening of seasonal extremes, suggesting potential for increased sediment supply, but also storms (Plomartis et al. 2015)
- In the near-term local anthropogenic action is far more relevant, common sense suggests:
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Future outlook

- The influence of plants needs to be included in coupled hydrodynamic-sediment models and this requires detailed vegetation type and morphological parameter data.
  - Forshore Assessment Using Space Technology (`www.fast-space-project.eu`)
  - see De Vries et al. PREDICTION OF FLOOD PROTECTION SERVICES DELIVERED BY FORESHORE ECOSYSTEMS USING SPACE BASED SENSORS Session 033: 16:15

Acknowledgements

EPM is supported by the EU FP7 project Forshore Assessment Using Space Technology (FAST, grant number 607131).

This work was financially supported by the Junta de Andalucia Projects P07-RNM-2516, P09-RNM-4853 and PR11-RNM-7722, Spanish project CTM2008-00012/MAR, a travel grant from the Schure-Beijerinck-Popping Fund (SBP/JK/2007-32), E.U. MarinERA Project MedEX (CTM2008-04036-E/MAR) and PERSEUS (FP7-287600).

Thanks to NASA for distributing the MODIS data and Junta de Andalucia (`http://www.juntadeandalucia.es/medioambiente/site/rediam`) for in situ and geospatial data.

A special thanks to J. Jimenez-Arias and co-authors for sharing sediment accretion rates and numerous colleagues for stimulating debate.